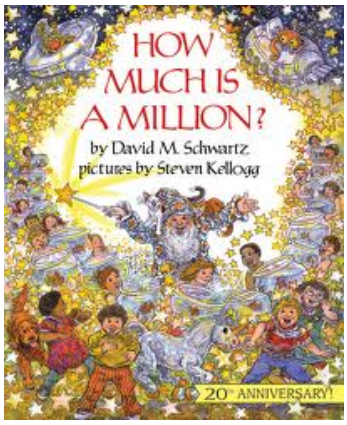
# Chapter 9 Exponents & Scientific Notation

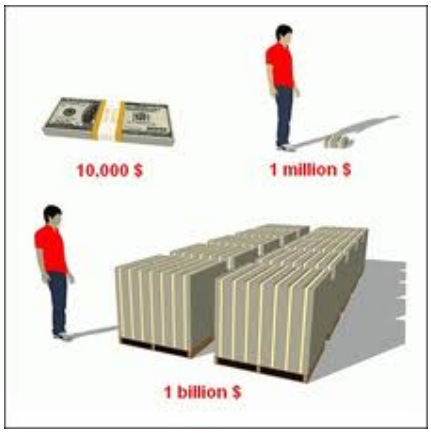
## 9.4 Zero and Negative Exponents

Unit Question: What is the power of powers?

Learner Profile: Reflective

Area of Interaction: Community & Service



# I Can Statement:

I can use the definitions of zero and negative exponents to evaluate and simplify expressions.

## Quiz

Paper out and do!!!

1. $7 \cdot 7 \cdot m \cdot m \cdot m$

$7^2 \cdot m^3$

2. $(-2)^6$

$(-2)\cdot(-2)(-2)(-2)(-2)(-2)$

3. $(3c)^4$

$81c^4$

4. $\left(-\frac{2}{7}p\right)^2$

$+\frac{4}{49}p^2$

5. $\dfrac{\pi^{15}}{\pi^3 \cdot \pi^9}$

$\pi^3$

6. **CRITICAL THINKING** Is $(ab)^2$ equivalent to $ab^2$? Explain. *(Section 9.2)*

No $ab \cdot ab = a^2b^2$

7. **EARTHQUAKES** An earthquake of magnitude 3.0 is $10^2$ times stronger than an earthquake of magnitude 1.0. An earthquake of magnitude 8.0 is $10^7$ times stronger than an earthquake of magnitude 1.0. How many times stronger is an earthquake of magnitude 8.0 than an earthquake of magnitude 3.0? *(Section 9.3)*

# Read the example.

Talk about the following notation.

Thousands Hundreds Tens Ones

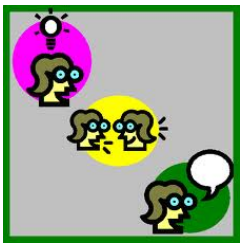
$$4327 = \underbrace{4 \cdot 10^3}_{4000} + \underbrace{3 \cdot 10^2}_{300} + \underbrace{2 \cdot 10^1}_{20} + \underbrace{7 \cdot 10^0}_{7}$$

What patterns do you see in the first three exponents?

Continue the pattern to find the fourth exponent.

How would you define $10^0$? Explain.

# Think, Pair, Share



How would you define $10^0$? Why?

$10^3$ 1000
$10^2$ 100
$10^1$ 10
$10^0$ 1
$10^{-1}$ 1/10
$10^{-2}$ 1/100

$2^3 = 8$
$2^2 = 4$
$2^1 = 2$
$2^0 = 1$

$2^4 = 16$ $2^{-4} = 1/16$

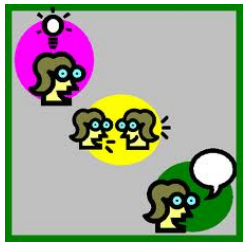
$2^3 = 8$ $2^{-3} = 1/8$

$2^2 = 4$ $2^{-2} = 1/4$

$2^1 = 2$ $2^{-1} = 1/2$

$2^0 = 1$

# Think, Pair, Share



Compare the two methods used to simplify $\frac{3^2}{3^5}$. Then describe how you can rewrite a power with a negative exponent as a fraction.

$\frac{3^2}{3^5}$

*Method 1*

$$\frac{3^2}{3^5} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{3}} \cdot 3 \cdot 3 \cdot 3}$$

$$= \frac{1}{3^3}$$

$\frac{1}{3^3}$

*Method 2*

$$\frac{3^2}{3^5} = 3^{2-5}$$

$$= 3^{-3}$$

$\frac{1}{3^3}$

On your paper with quiz, answer the question.

# Think, Write, Share

**IN YOUR OWN WORDS** How can you define zero and negative exponents? Give two examples of each.

1 minute to write, then I will say when to share.

## Key Ideas

### Zero Exponents

**Words** Any nonzero number to the zero power is equal to 1. Zero to the zero power, $0^0$, is *undefined*.

**Numbers** $4^0 = 1$ **Algebra** $a^0 = 1$, where $a \neq 0$

### Negative Exponents

**Words** For any integer $n$ and any number $a$ not equal to 0, $a^{-n}$ is equal to 1 divided by $a^n$.

**Numbers** $4^{-2} = \frac{1}{4^2}$ **Algebra** $a^{-n} = \frac{1}{a^n}$, where $a \neq 0$

What if you have $\frac{1}{a^{-n}}$ $\frac{1}{4^{-2}}$ $4^2$

Evaluate the expression. Put on paper.

1. $4^{-2}$

$\frac{1}{4^2} = \frac{1}{16}$

2. $(-2)^{-5}$

$\frac{1}{(-2)^5}$

3. $6^{-8} * \frac{6^8}{}$

$6^{-8+8}$

$6^0$

$\frac{6^8}{6^8} = 1$

Evaluate the expression. Put on paper.

4. $\frac{(-3)^5}{(-3)^6}$

$(-3)^{5-6}$

$\frac{\cancel{-3}\cdot\cancel{-3}\cdot\cancel{-3}\cdot\cancel{-3}\cdot\cancel{-3}}{\cancel{-3}\cdot\cancel{-3}\cdot\cancel{-3}\cdot\cancel{-3}\cdot\cancel{-3}\cdot-3}$

$(-3)^{-1} = \frac{1}{-3^1}$

5. $\frac{1}{5^7} * \frac{1}{5^{-4}}$

$\frac{1}{5^7 \cdot 5^{-4}}$ $\frac{1}{5^3}$

$\frac{1}{5^7} \cdot \frac{5^4}{1} = 5^{-3}$

Evaluate the expression. Put on paper.

$$\frac{-2a^3}{10a^8} = \frac{-1}{5a^5}$$

$$a^{-5} = \frac{1}{a^5}$$

Evaluate the expression.

Put on paper.

$$\frac{p^{-4}q^{-3}}{(p^{5}q^{2})^{-1}}$$

Remember the previous lesson. Power of a power.

$p^{-4-(-5)}$

$q^{-3-(-2)}$

$q^{-1}$

$$\frac{p^{-4}q^{-3}}{p^{-5}q^{-2}} = \frac{p^{5}}{p^{4}}\frac{q^{2}}{q^{3}} = \frac{p}{q}$$

Put on paper.

Exit Quiz!!!

$-9xy^3z^6$

Simply:

1. $(4x)^{-3}$

$\frac{1}{(4x)^3}$

2. $\left(\frac{3x^5y}{8xy^7}\right)^0$

$=1$

3. $\frac{18x^3y^4z^7}{-2x^2yz}$

# I Can Statement:

I can use the definitions of zero and negative exponents to evaluate and simplify expressions.

# Assignment:

Book: p.374-375
#13-32.

Due tomorrow at the beginning of class!!